Utilities Response to Climate Change

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A serious discussion of climate change must include the contribution that electric utilities make to greenhouse gas emissions (GHG). In the U.S. the utilities contribute about one-third of the total man-made CO_2 emissions. On a worldwide basis the utilities contribution is a somewhat lower percentage but certainly significant. The contribution is the direct result of the burning of fossil fuels (coal, oil and gas) in boilers. Industrial and commercial entities who burn these fuels also add to the CO_2 emitted.

To begin to understand how utility CO_2 emissions can be reduced, it is useful to look at the energy sources used to produce electricity. Figure 1 shows that in 1995 about three-fourths of U.S. electricity came from fossil fuels, 40 percent of which was from coal, the highest CO_2 emitter of the three fossil fuels. Most of the remaining one-fourth came from energy sources with zero emissions, hydro and nuclear, in other words good resources from a climate change viewpoint.

If we look at how New England obtained its electricity in 1995 only about 55 percent came from fossil resources, and one-third of that was from coal. Our region did a little better than the U.S. with its 25 percent contribution from nuclear energy versus 13 percent for the U.S., but only 5 percent from hydro versus 13 percent from the U.S. The other 15 percent came from power purchased from other utilities or independent power producers. Some of the purchased power came from hydro and other renewables. So, overall, our region is ahead of the U.S. in lower CO_2 emissions per kWh.

We can get a sharper picture of this comparison and also include just Northeast Utilities (NU) looking at Figure 2. Here we see the lbs of CO_2 emitted for each kWh produced for the Midwest, where we know most of the coal burning takes place, for the total U.S. For NU, and for the rest of New England. This shows a definite improvement in the reduction of CO_2 per kWh for all categories. NU has the lowest level of CO_2 per kWh shown, or about half that compared to the others. The graph is for a normal nuclear operating year when we expect about 50% or more of our electricity to be generated by nuclear energy.

But this doesn't tell the whole story or the problem we face relative to climate challenge. Electricity growth continues and is forecasted to growth at about one percent per year for our company while other regions will have higher growth rates. The key question is how will they add the resources needed to serve this growth while trying to reduce their overall CO_2 emissions? The U.S. utility CO_2 emissions are about 700 MTCE and will likely grow. But the industry is responding to help curb this growth. As a benchmark New England utilities emitted about 54 million (short) tons of CO_2 in 1990, the year which is being used as a baseline year for climate change policy planning. While the region's CO_2 emissions are down from that level in this decade, they are expected to rise above it under normal growth scenarios shortly after 2000. But before we discuss what is being done specifically to mitigate this growth, let's consider some electric utility industry trends that maybe helping or hurting this growth from a climate change viewpoint. These trends are shown in Table 1.

Table 1. Electric Energy Trends

- Restructuring the electric utility industry
- Smaller unit sizes
- Increased need for power quality
- Increased attention to environmental performance
- Increased use of natural gas
- Increased use of renewable technologies, DSM and conservation

Probably the trend with most uncertainty is the restructuring of the electric industry. For example as power plants become spun off under unregulated subsidiaries, what will be their inclination to reduce CO_2 when they are trying to compete at the lowest busbar cost? The last three trends are of more direct interest to us. Attention to environmental performance may bring about standards

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that require a certain emissions level for CO_2 per kWh. One of the biggest contributors to lowering CO_2 is the increased use of natural gas. Not only is it the lowest CO_2 emitting fossil fuel, but the combined cycle plants that are being built today are using new combustion turbine designs that achieve a total plant efficiency of over 40 percent, well above today's typical fossil steam plant, and they are going higher. As these replace older existing plants burning oil and coal in the dispatch we are reducing the CO_2 per kWh. Finally, there is an growing interest in using renewable technologies with zero CO_2 emissions and doing more conservation. Renewables will help, but they are not liking to have the biggest impact for some time given their high cost. A great example of where using renewables is appropriate is some new entrepreneurial firms are marketing 50 watt photovoltaic standalone solar panels to third world villagers for lighting and cooking. The solar energy will replace their use of kerosene and wood and reduce CO_2 while improving their standard of living.

With this brief background let us look at some policy options that are being considered by the U.S. Government and at other international groups involved in climate change policy discussions. These are listed in Table 2.

Emission caps or budgets along with credit trading have been the basis to use market forces to help achieve lower SO_2 and NO_x emissions from utility power plants in the U.S. These have been by and large successful. Fuel subsidies and taxes are very political and are being considered. along with generation performance standards especially related to older plants.

Table 2. Some Policy Options to Reduce CO_2

- Set CO_2 targets: emission caps or budgets, % reductions
- Recognize voluntary early reductions
- Reduce subsidies or establish taxes
- Set generation performance standards, renewable portfolios
- Establish CO_2 credit trading

What have been some of the lessons learned from SO_2 and NO_x regulations? First, while there are other large sources for both SO_2 and NO_x emissions, utilities have been the bigger focus for developing regulations to reduce these emissions. Second, the cost for utilities to comply has often been less than originally projected or claimed, especially, by those opposing the regulations. Third, other factors can help reduce emissions: fuel switching, plant retirements, etc. So while we the utility industry will continue to be a major target for reductions, the pain should not be as great as we might first think, especially if we integrate our responses with other advantageous steps we take in the deregulated market. One such step is to respond to a certain portion of the electric consumers who are willing to pay for "Green Power". This can help drive our use of renewable resources.

You may have gotten some idea already of how can we produce less CO_2 from electricity. Table 3 shows general directions that may have been obvious from the earlier discussion.

Table 3. How to produce less CO_2 from electricity?

- Use less energy, i.e. conservation
- Use sources that produce less CO_2/kWh
  - $\Rightarrow$ Fossil fuel with lower CO_2 emissions
  - $\Rightarrow$ Higher efficiency technologies
  - $\Rightarrow$ Zero emitting sources: solar, wind, hydro, nuclear

Certainly it makes common sense to use less energy to do a given task. Electricity can help here. For example, faxing a 20-page document across country versus mailing it has been estimated to save 2 lbs of CO_2 emissions. The best approach for reducing CO_2 is to use the fossil fuels with lower emissions of CO_2 i.e. natural gas, and this is a trend we have seen. Higher efficiency generation technologies are entering the marketplace with combined cycle plants above 40 percent and fuel cells that, in conjunction with microturbines, can ultimately reach over 60 percent. These fuel cells are some years away though from being commercial. Finally, there are the zero emitting technologies: solar, wind, hydro and let's not overlook the big benefit nuclear brings to reducing CO_2. Despite all of its other problems, with new developments and growing climate change concerns in the next century there may be a role nuclear can continue to play here.

Let's now turn to what is being done by the electric utility industry to respond to the need for GHG reductions. As part of the President's Climate Change Action Plan issued 1993 the DOE worked in conjunction with the electric utility industry trade groups to develop a program that would encourage and recognize voluntary actions by individual utilities to reduce or avoid GHG emissions. The progress that has been made with

this program is summarized in Table 4. What is important is the level of participation that is encompassed by these agreements as well as the variety of approaches being used to make the reductions: system reductions of CO_2 emissions, improved use of nuclear plants, conservation, efficiency improvements in the generation of electricity, management of forests and many more. The tracking of the progress of these commitments is done through annual filings under the 1605b Voluntary Reporting of Greenhouse Gas Emissions, set up by the National Energy Policy Act of 1992. A key policy element for the utility industry is to be sure that the agreements coming out of Kyoto in December recognize early voluntary reductions. The U.S. position currently does not.

Table 4: Utility Responses to DOE Climate Challenge

- Memo of Understanding in April 1994
- Voluntary agreements between utilities and DOE
- 120 agreements signed, 636 individual utilities have made pledges
- Total reductions promised by 2000: 44 MTCE

What may be of more interest for this audience is what has NU done under this program? Figure 3 shows the NU commitment made under its Climate Challenge Agreement is a one million ton reduction from the NU baseline emissions (average of 1987-1990) by the year 2000. It also includes a cumulative reduction of three million tons from 1995 to 2000. These are in short tons. The figure shows the actual emissions to date being well below our yearly targets. This is in spite of our two recent bad nuclear operating years. Hopefully, the margin by which we meet our pledge will increase as our nuclear plants come back on line in 1998.

Let's also look at two renewable energy projects that contribute to GHG reductions, but for which NU is not taking any credit in its Climate Challenge pledge. One involves fuel cells and the other wind power. NU is operating a 200 kW fuel cell at a landfill in Groton, CT using about one fifth of the available landfill gas being collected. Prior to the fuel cell being installed, the landfill was flaring the gas which burned the methane component yielding CO_2 a much less potent GHG than the methane being released. The fuel cell improves this by converting the methane after some cleanup into electricity, CO_2 and water. What is of more interest is that we plan to install a 3 to 4 acre hydroponic greenhouse to grow vegetables year around. This greenhouse would use the electricity from the fuel cell plus some electricity from the grid, and the CO_2 along with some additional heat. A conceptual view of this is shown in Figure 4. The idea behind turning the wastes from the landfill into useful products is industrial ecology. NU has been awarded DOE rebates for 10 more of these 200 kW fuel cells and we hope to replicate this idea at one or more landfill sites in Connecticut. We have calculated that about 11,000 tons per year MCTE would be reduced by this project at Groton when fully developed. We have also received a letter of intent from a group of Canadian industries to purchase 1000 tons of these reductions as credits for 10 ten years. We believe this purchase could demonstrate a first international commercial transaction of carbon credits, and would be an important step toward establishing a carbon credit trading mechanism.

The second renewable energy area, wind power, includes two efforts: one is a 20 MW operating wind farm in Costa Rica with the NU's subsidiary Charter Oak Energy as the principal owner. The farm has 55 wind turbines operating a one of the world's best wind sites. It is expected to yield about 260,000 MTCE by the year 2000 by avoiding the Costa Rican electric system's fossil emissions that would otherwise be produced.

The second wind effort about to get underway should be of particular interest here in New Hampshire. It is a three-year wind assessment which includes two years of detailed measurements at wind sites yet to be selected. NU is sponsoring this research project jointly with the NH Governor's Office and we expect to announce the contract award later this month. The results of this research project can provide a solid basis to plan wind power projects at the selected sites. We are also finishing up a similar project in Massachusetts with UMASS as the contractor. Such projects would of course reduce GHG emissions similar to the Costa Rica project. Last month Green Mountain Power dedicated the largest wind project in the East at Searsburg in southern Vermont. It is a 11 turbine 6 MW installation and expects to save over 11,000 (short) tons of CO_2 emissions.

One last important area to touch on is Joint Implementation (JI) or also called Activities Implemented Jointly or AJI. This is a U.S. Pilot Program Initiative that seeks to do projects cooperatively in two or more countries that reduce GHG. These JI projects are voluntary and to date 26 have been recognized by the U.S. committee overseeing this Program. Our Costa Rica wind farm was among the first recognized in this program. There is not yet international consensus for JI in the climate change discussions. But the U.S. through this pilot

program hopes to set an example that can be the basis for international projects that can provide reductions and marketable credits to the countries and entities involved.

Finally I want to end offering a list of issues that are important to utilities in the outcome of both deregulation and the climate change negotiations. This are listed in Table 5. These are not meant to be inclusive but ones which stand out to us at NU as key issues to resolve.

Table 5: Issues for Utilities on Climate

- ChangeContinue investing in and promoting more efficient energy use and conversion processes
- Plan transition toward zero emitting energy sources and technologies
- How to recover costs of CO_2 reductions in a competitive generation market
- Remain a major player in climate change policy discussions
- Promote JI projects and GHG credit trading system

Figure 1.

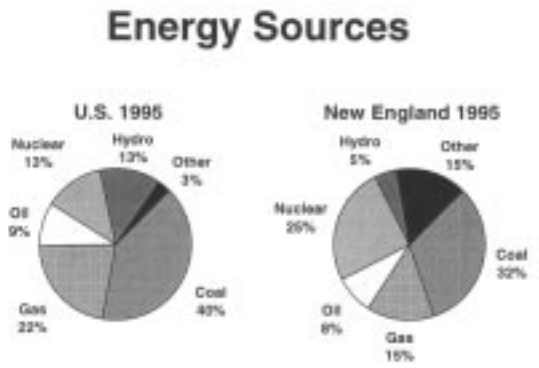

Figure 2.

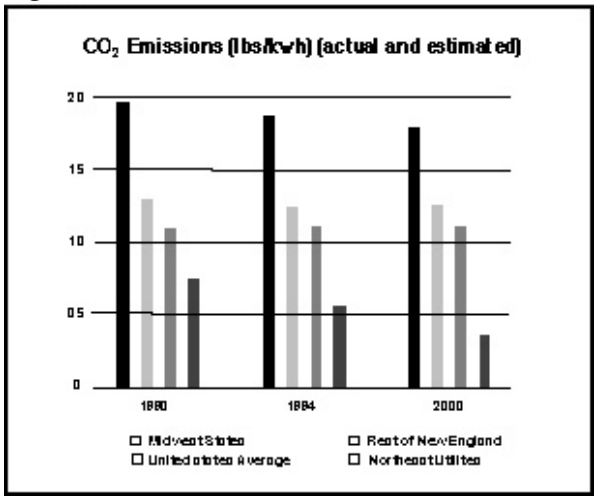

Figure 3.

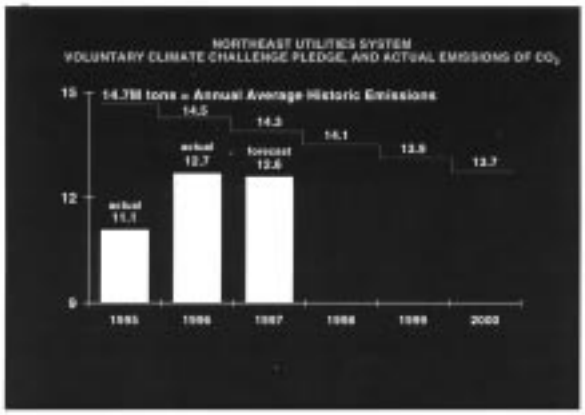

Figure 4.